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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/811,230	03/26/2004	Seshadri Ganguli	005975/P2	8995

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EXAMINER

STOUFFER, KELLY M

ART UNIT PAPER NUMBER

1762

DATE MAILED: 10/10/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/811,230

Applicant(s)

GANGULI ET AL.

Examiner

Kelly Stouffer

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 March 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-55 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-55 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 26 March 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 9/23/2004 5/25/2005 10/27/2005.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: chamber lid 132 defined in paragraph 0044 lines 1 and 2 of the specification. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

2. The disclosure is objected to because of the following informalities:

The reference characters 46A in Figure 1 and 162, 152A, 152B, 170, and 172 in Figure 2 are not in the specification.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 18, 23-26, and 44-49 are rejected under 35 U.S.C. 102(e) as being anticipated by US Patent publication 2003/0165615 to Aaltonen et al. Aaltonen et al. discloses a method of forming a ruthenium layer on a substrate for use in an integrated circuit fabrication by depositing a barrier layer of tantalum silicon nitride by an ALD process (paragraph 0063) then depositing a ruthenium layer by a second ALD process (paragraph 0064 lines 1 and 2). The ruthenium layer is deposited by pulsing a ruthenium precursor into a chamber and exposing it to the barrier layer and therefore chemisorbing it, and exposing the ruthenium layer to a reducing gas and reacting it to form the ruthenium layer, with purge gas pulses in between the pulses of reactant gases (paragraph 0021). Thus Aaltonen et al. meets all the recitations of claim 18 at least as broadly recited by claim 18.

Regarding claim 23, Aaltonen et al. discloses the reducing gas to comprise oxygen or nitrous oxide in paragraph 0056 and 0019.

Regarding claim 24, Aaltonen et al. discloses the ruthenium layer being formed at 300-360 °C (paragraph 0059).

Regarding claims 25 and 26, Aaltonen et al. discloses the ruthenium layer to be able to have a thickness of about 100 Å (paragraph 0071) and discloses the resistivity as less than 15 µohms-cm which given the corresponding thickness gives a sheet

resistance of less than 2000 ohms/sq. when calculated in Tables 1-3. A lesser thickness, according to the conditions set forth in Tables 1-3, (for example less than 100 A) would follow the trend and give an even smaller resistivity.

Regarding claims 44-49, Aaltonen et al. includes the provisions as discussed above and additionally discloses forming the ruthenium on a low-k material (paragraphs 0063 and 0064) and the ruthenium-containing compound having at least one open chain dienyl ligand (paragraph 0054).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation

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under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 1-17, 19-22, 27-43 and 50-55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Aaltonen et al. in view of US patent publication 2002/0173054 to Kim. Regarding claim 1, Aaltonen is discussed above and includes the provisions of claim 1 except for the claimed ruthenium compounds. Kim teaches a similar ALD process with a ruthenium precursor, oxygen as a reductant, and inert gas pulses in-between reactant pulses that uses C1-C8 alkylcyclopentadienyl and its derivatives (paragraphs 0019- 0020) in order to remove the neutral products of the reaction between the reducing agent and the ligands in vapor form by a vacuum pump (paragraphs 0005-0011).

It would have been obvious to one of ordinary skill in the art to modify Aaltonen et al. to include the claimed ruthenium precursor compounds such as C1-C8 alkylcyclopentadienyl compounds as taught by Kim in order to remove the neutral products of the reaction between the reducing agent and the ligands in vapor form by a vacuum pump.

Regarding claims 2-4, Kim uses C1-C8 alkylcyclopentadienyl and its derivatives (paragraph 0020) as ligands in the ruthenium precursor.

Claims 5-10 are disclosed by Aaltonen et al. as described above.

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Aaltonen et al. in view of Kim includes all of the provisions of claim 11, as C1-C8 alkylcyclopentadienyl and its derivatives (paragraph 0020) as ligands for the ruthenium precursor taught by Kim include bis(2,4-dimethylpentadienyl)ruthenium.

Claims 12-17, 23-26 are disclosed by Aaltonen et al. as described above.

Claims 19-22 are disclosed by Kim as discussed above.

Aaltonen et al. in view of Kim includes all of the provisions of claims 27 and 36 as discussed above.

Claims 28-30, 37-40, and 50-53 are disclosed by Kim as discussed above and claims 31-35, and 41-43 are disclosed by Aaltonen et al. as described above.

Aaltonen et al. in view of Kim includes all of the provisions of claim 54 as discussed above.

Regarding claim 55, Aaltonen et al. in view of Kim includes all the requirements of claim 55, and additionally Aaltonen et al. discloses the ruthenium layer as a seed layer for copper deposition and being deposited overtop a barrier layer in paragraph 0006.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422

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F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

5. Claims 1- 4, 11, 27-30 and 36-40 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-2 and 27-29 of copending Application No. 10/634662. Although the conflicting claims are not identical, they are not patentably distinct from each other because the claims of copending Application No. 10/634662 teach forming a ruthenium film on the substrate using the same precursors and a reducing agent, but with ALD. One of ordinary skill in the art would recognize that an ALD process is what is defined by the present Applicant, exposing the substrate to pulses of ruthenium precursor, purge gas, reductant, and purge gas.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

6. Claims 9-10, 16-18, 35, 44, 48, and 54-55 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1,2 and 27-29 of copending Application No. 10/634662 in view of Aaltonen et al. Claims 1,2 and 27-29 of copending Application No. 10/634662 include the features of the present application as discussed above, but do not include a barrier layer, a low k

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containing substrate, and layers to make integrated circuits. Aaltonen et al. teaches that the ruthenium layer is deposited on a diffusion barrier material and is also a seed layer for copper deposition to make an integrated circuit (0006). The insulating layer on the substrate is silicon dioxide and the barrier layer is tantalum silicon nitride (paragraph 0063) as required by the applicant's claims. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify claims 1,2 and 27-29 of copending Application No. 10/634662 to include the ruthenium layer as a seed layer for copper deposition on top of a barrier layer and low-k dielectric containing substrate as taught by Aaltonen et al. in order to use the invention for integrated circuit fabrication.

This is a provisional obviousness-type double patenting rejection.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. DelaRosa et al. includes a similar ALD process for depositing ruthenium.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kelly Stouffer whose telephone number is (571) 272-2668. The examiner can normally be reached on Monday - Thursday 7:00-5:30.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Kelly Stouffer
Examiner
Art Unit 1762

kms



TIMOTHY MEEKS
SUPERVISORY PATENT EXAMINER